

Armed Forces College of Medicine

AFCM



The Cerebellum

Anatomy and) (Histology

By

Prof. Dr. Walaa Baher (Assistant professor of Histology)

INTENDED LEARNING OBJECTIVES (ILO)

By the end of this lecture the student will be able to:

- **Identify surfaces and major fissures of cerebellum.**
- **Classify the cerebellum into lobes anatomically and functionally.**
- **Enumerate arteries supplying cerebellum.**
- **List the layers of the cerebellar cortex and the cells forming them.**
- **Describe microscopic structure of cells in different layers of the cerebellar cortex.**



Anatomy of the Cerebellum

By

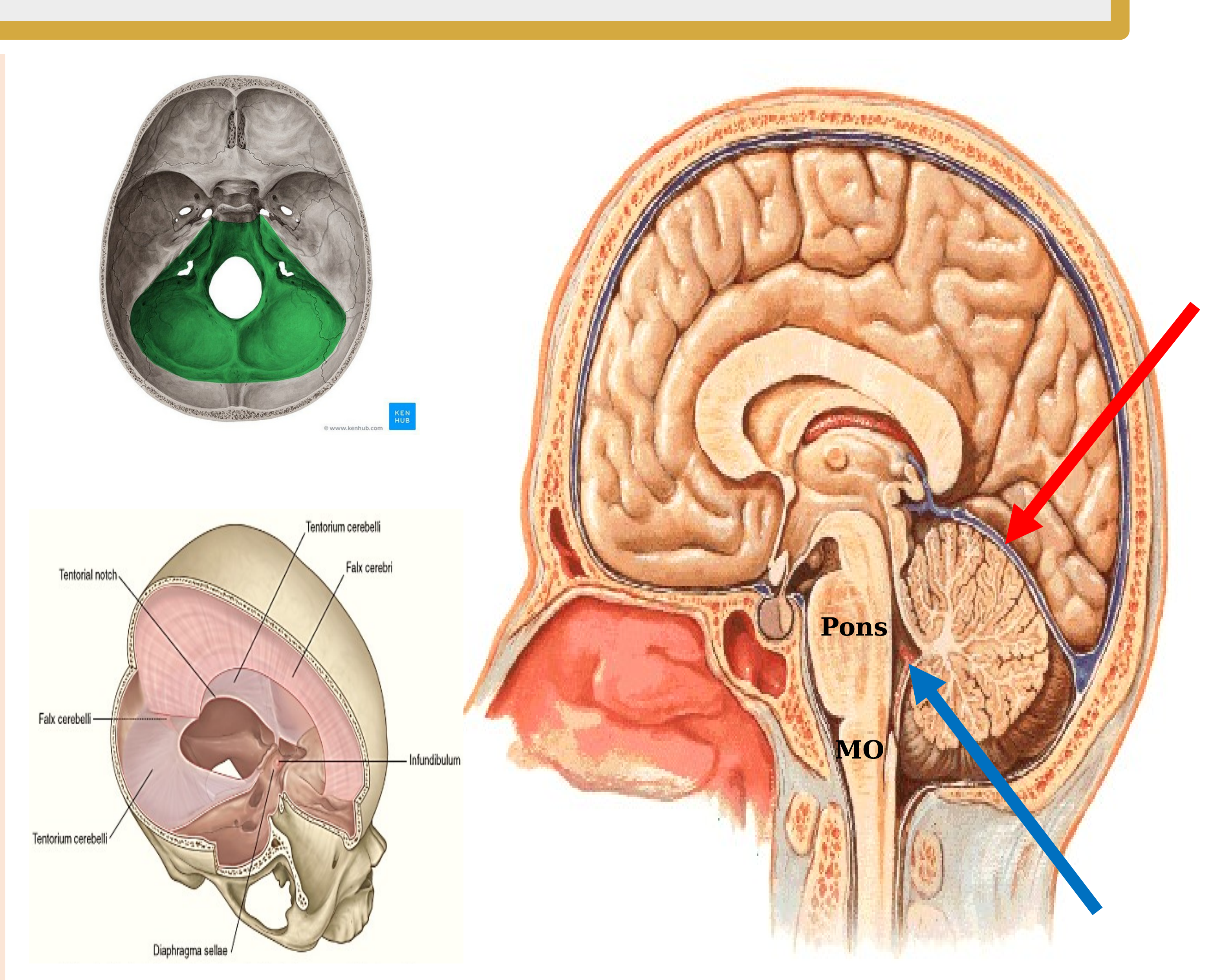
Dr. Hagar Yousry Rady

Lecturer of Anatomy and

The Cerebellum

➢ Site:

- Lies in the **posterior cranial fossa**.
- **Below the tentorium cerebelli** separating it from the cerebrum.
- It lies **posterior to the pons and medulla** with

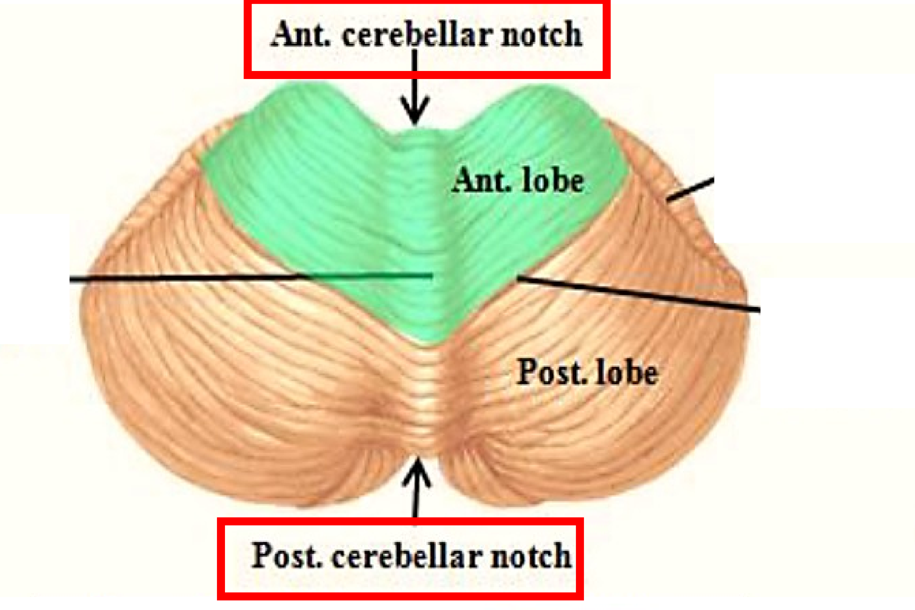


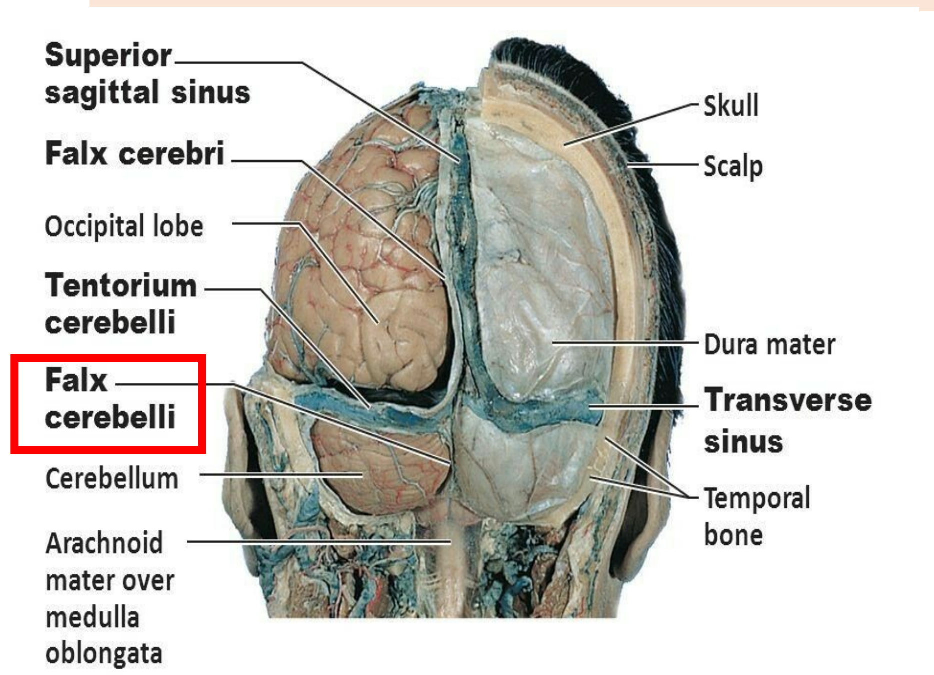
The Cerebellum

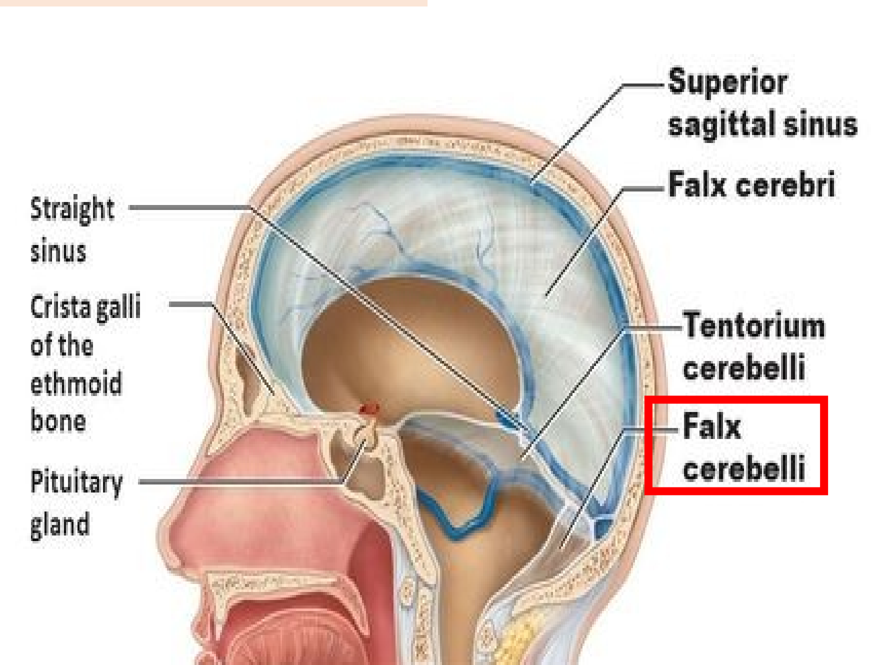
➢ **It has 2 notches:**

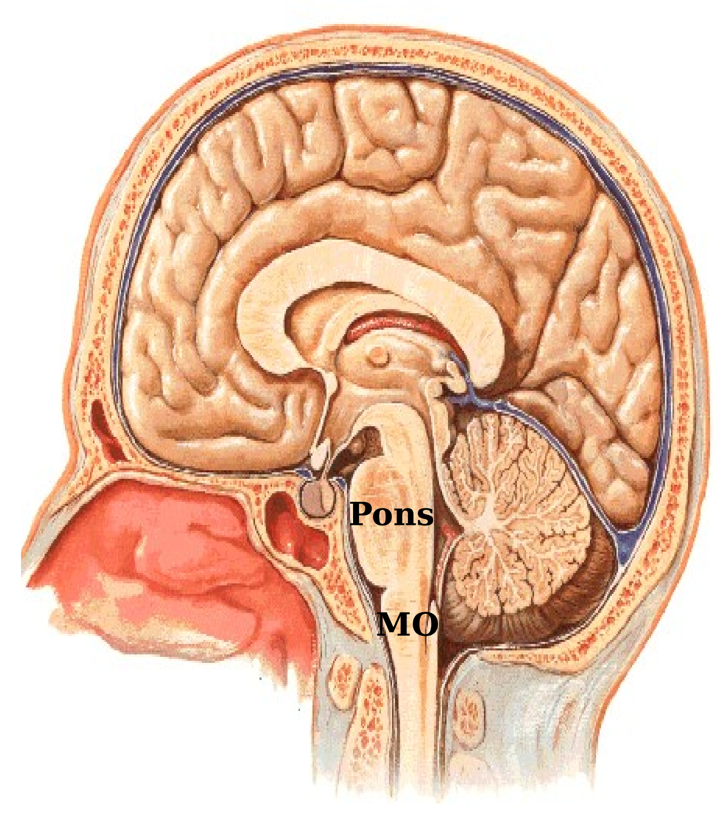
1- Anterior notch **which lodges the pons and medulla.**

2- Posterior notch **that lodges the falx**



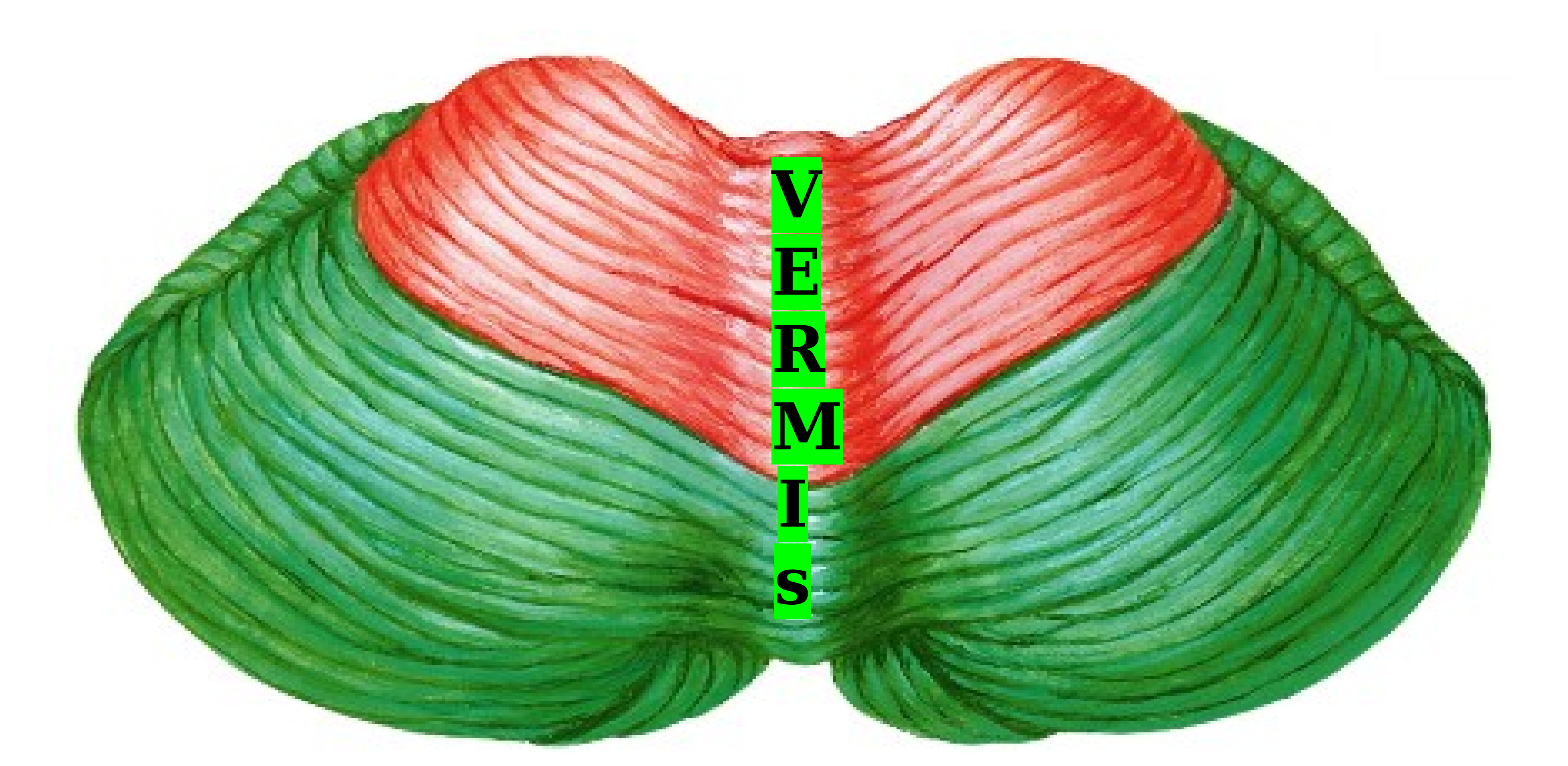






The Cerebellum

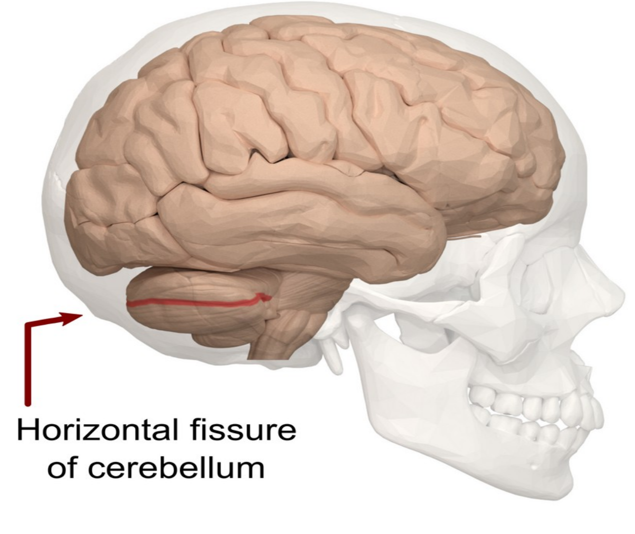
It is formed of <u>2 cerebellar hemispheres</u> joined by a median narrow part, <u>the vermis.</u>

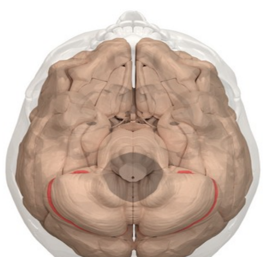


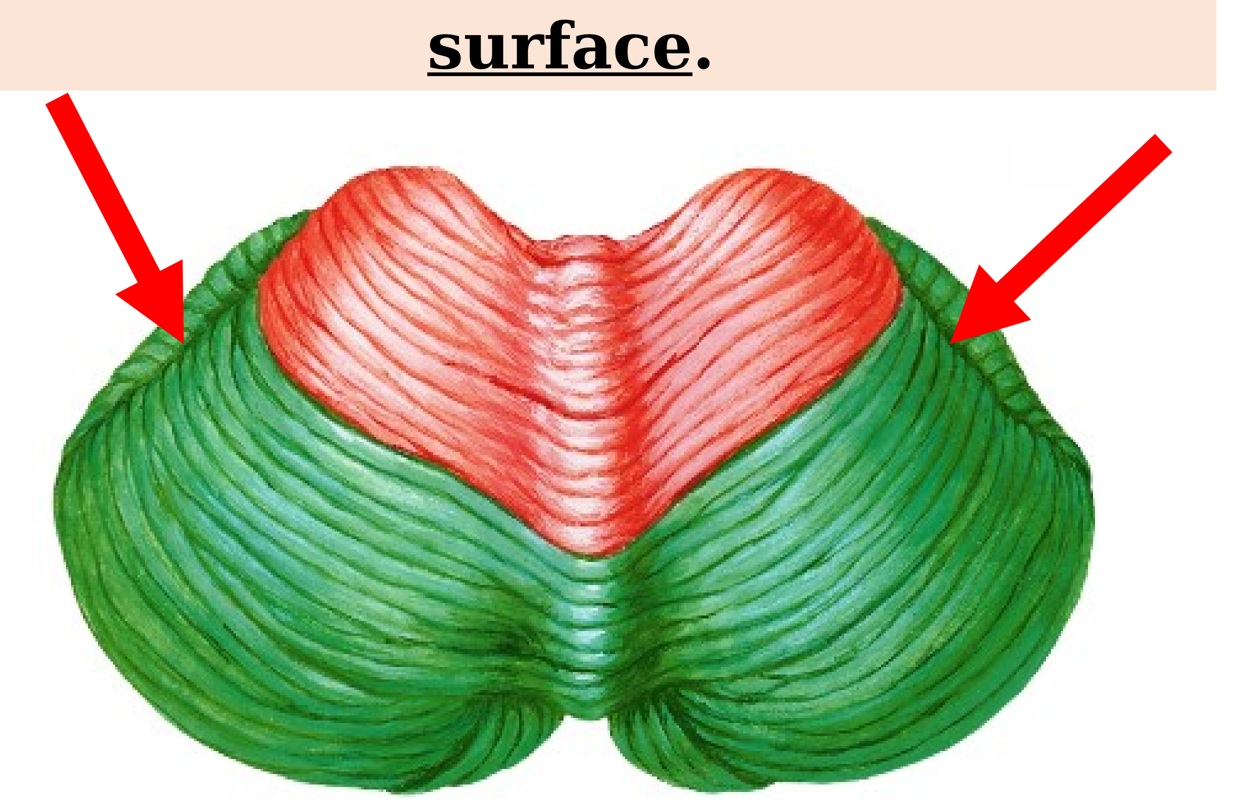
The Cerebellum

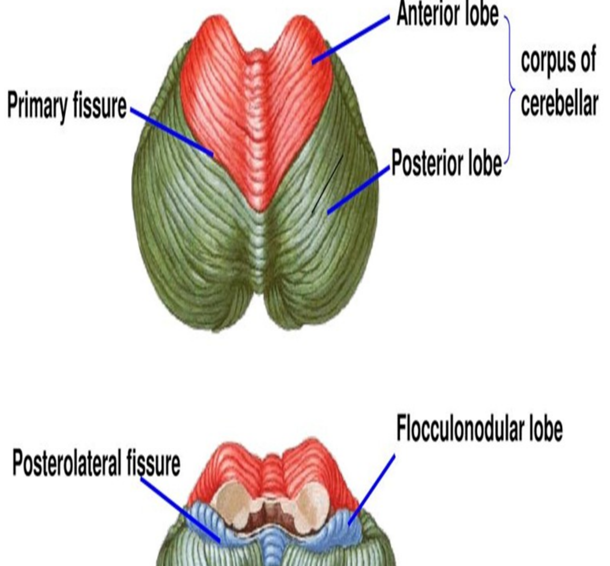
The surface of the cerebellum shows many fissures.

A deep fissure, the horizontal fissure, lies along the margin of the cerebellum and separates the superior from the inferior surface.







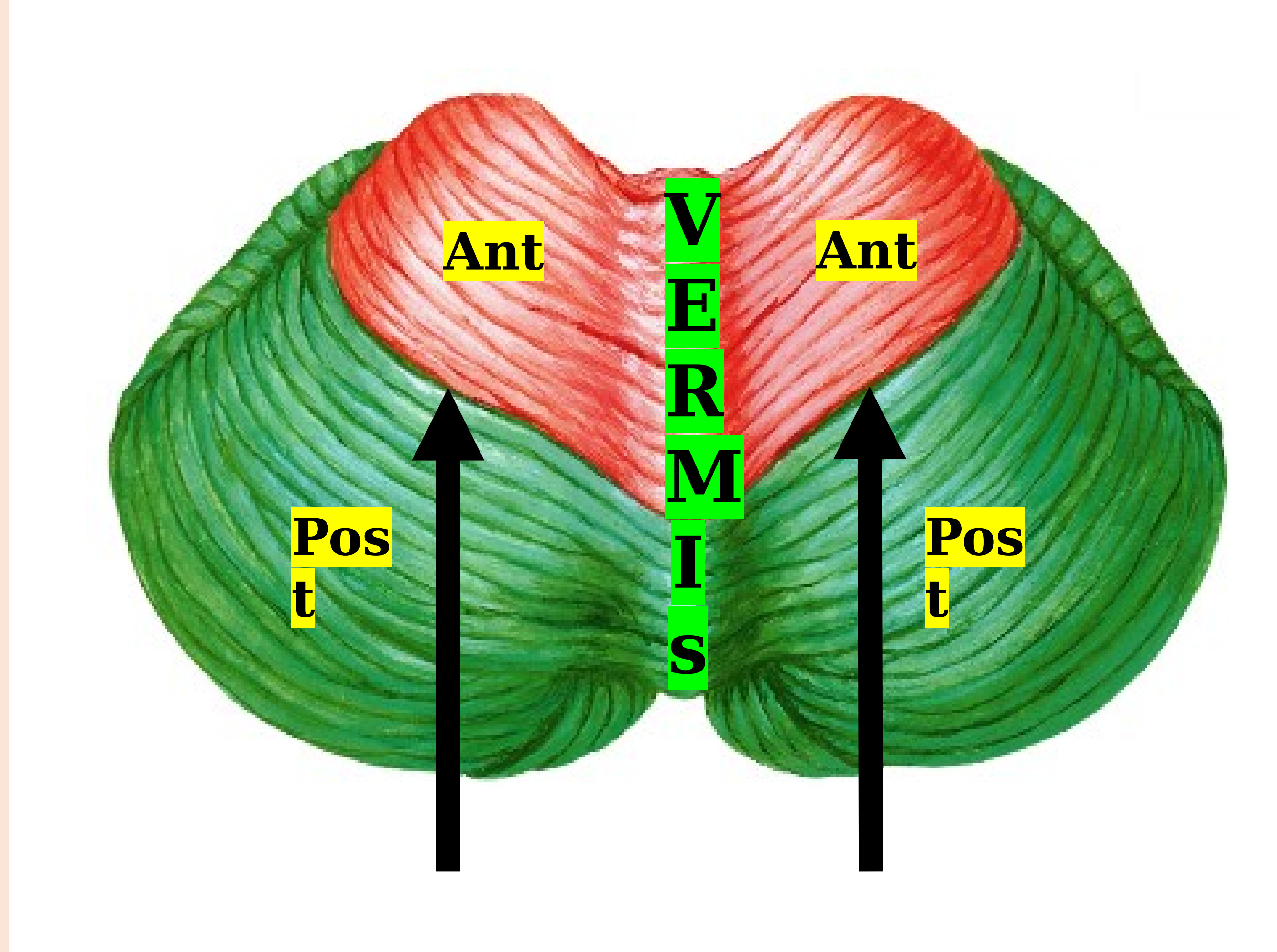


Surfaces of the Cerebellum

I. Superior Surface:

- It shows the superior vermis raised more than the cerebellar hemispheres.

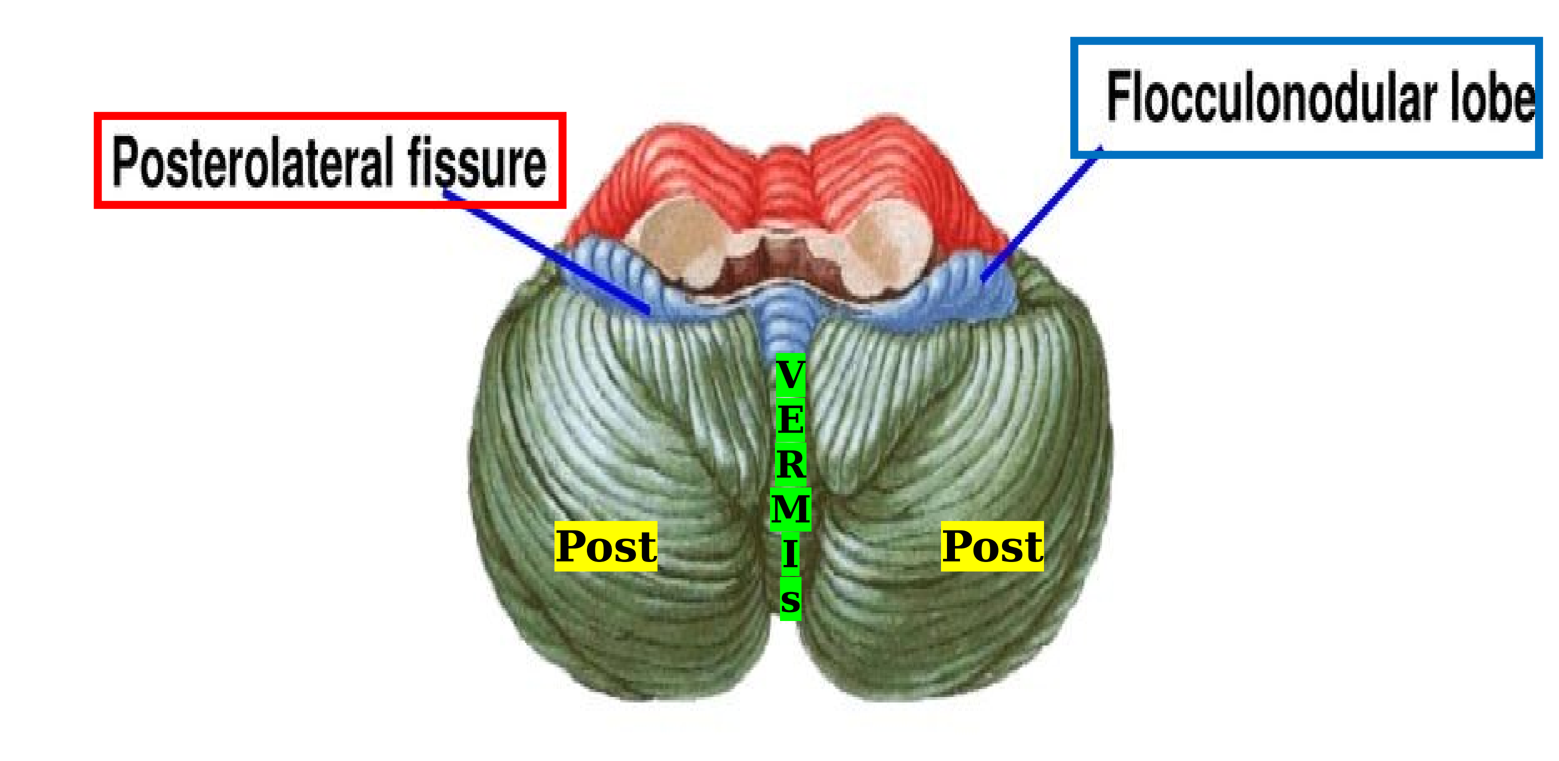
- It shows a deep fissure, Primary fissure, that separates anterior lobe from posterior lobe of cerebellum.



Surfaces of the Cerebellum

II. Inferior Surface:

- **The inferior vermis is present in a deep groove, vallecula that lies between the two cerebellar hemispheres.**



- **A posterolateral fissure separates the posterior**

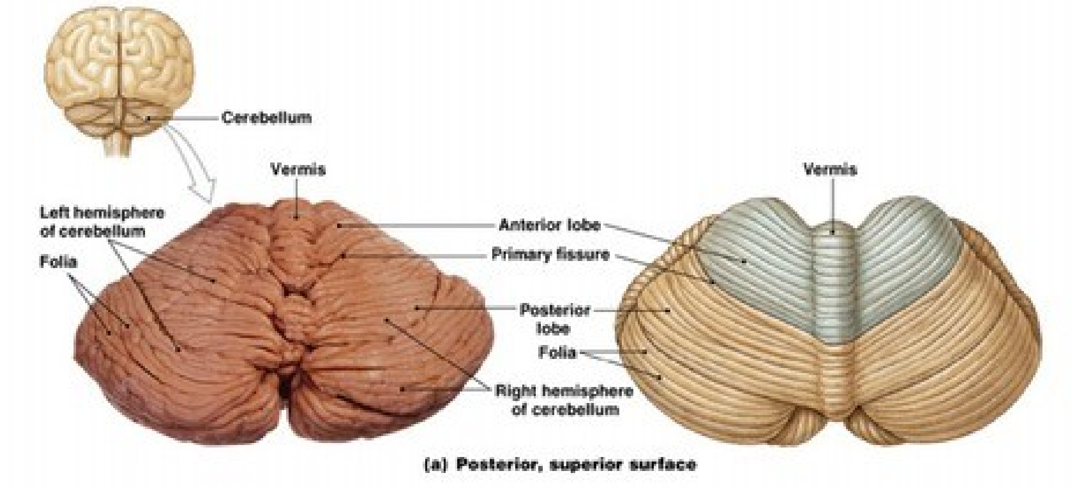
The Grey Matter of the Cerebellum

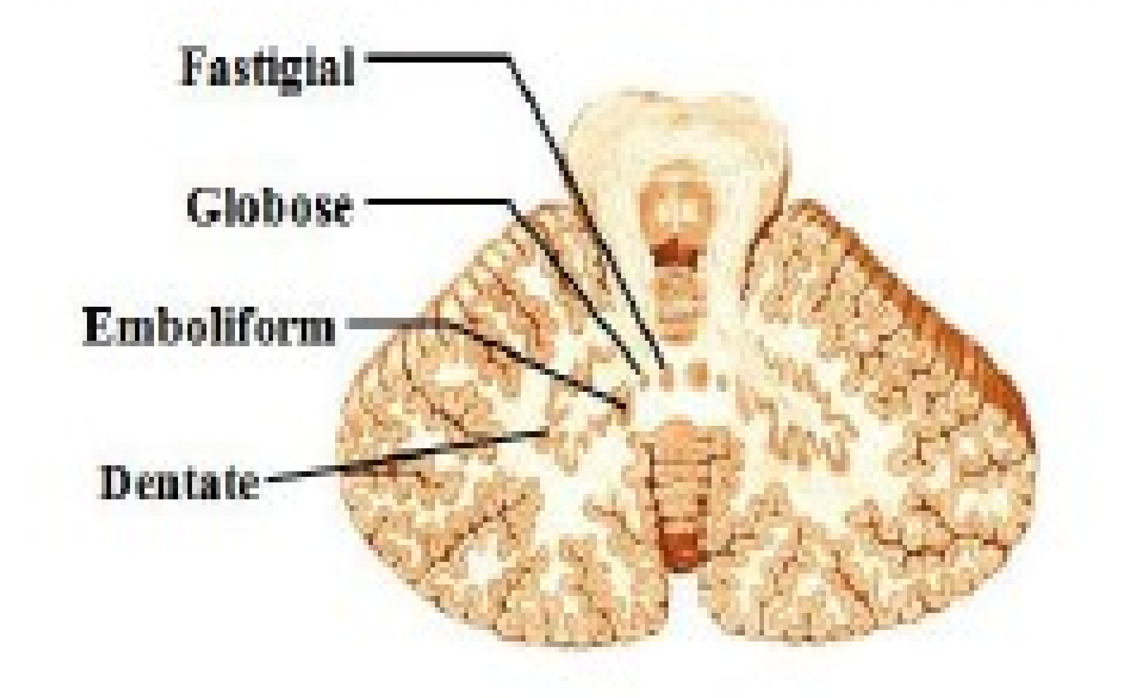
1. **Cerebellar cortex (on the surface).**

The cortex is folded by parallel and transverse fissures into *folia.*

2. Cerebellar nuclei (scattered in the white matter core).

They include the Dentate, Emboliform, Globose and Fastigial nuclei from lateral to medial.





Lobes of the Cerebellum

Anatomical Classification

1. Anterior lobe
2. Posterior lobe
3. Folluculonodular

Functional Classification

1. Archicerebellum
2. Paleocerebellum
3. Neocerebellum

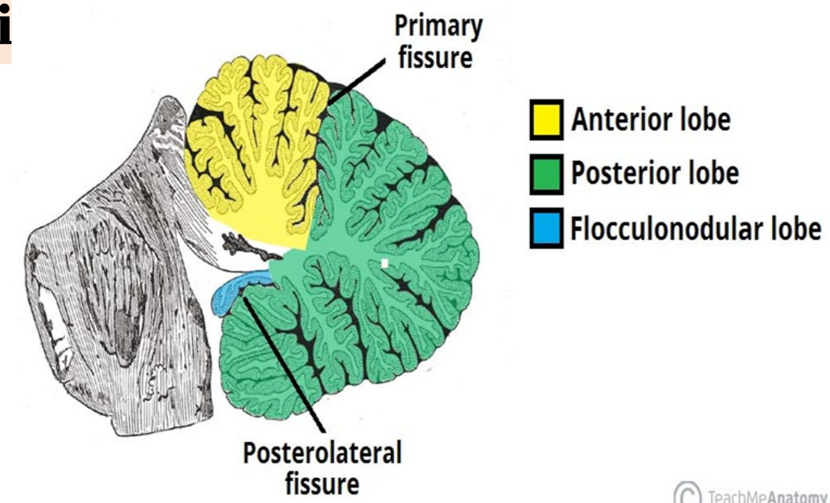
Lobes of the Cerebellum

➢ **Anatomically the cerebellum is divided into 3 lobes:**

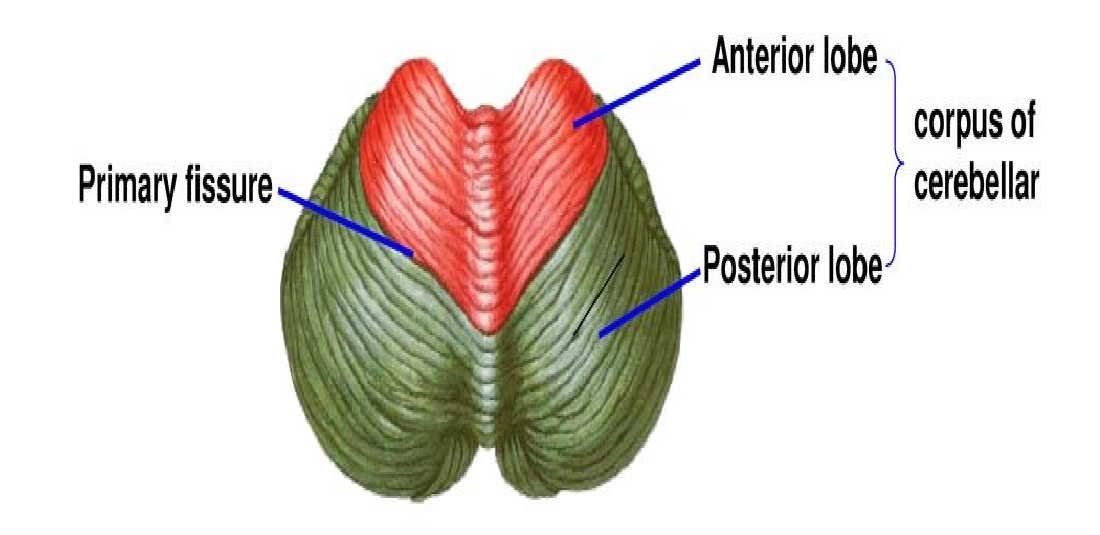
1. Anterior lobe: infront of the primary fissure.

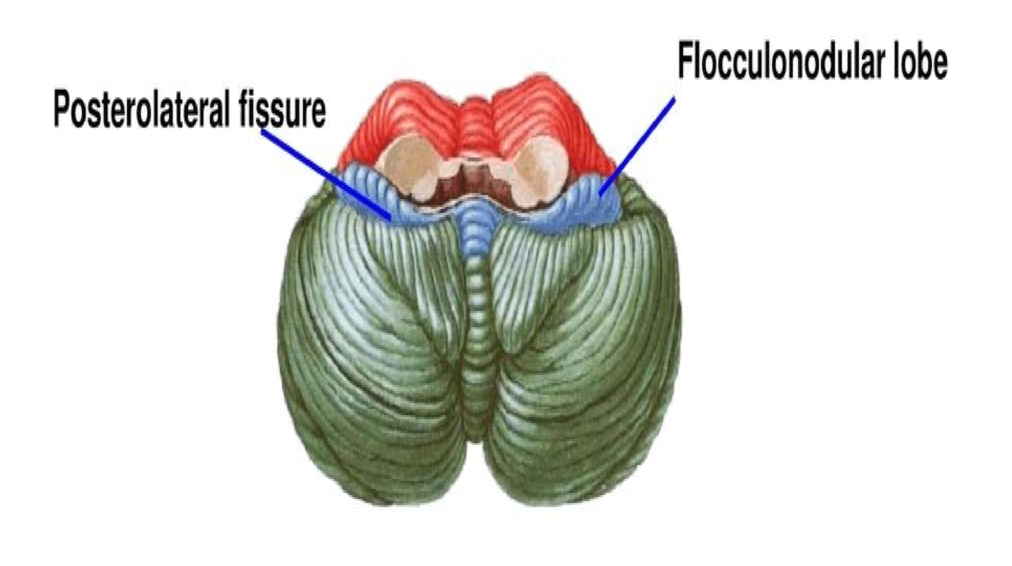
2. Posterior lobe: behind the primary fissure.

3. Flocculonodular lobe: separated from posteri

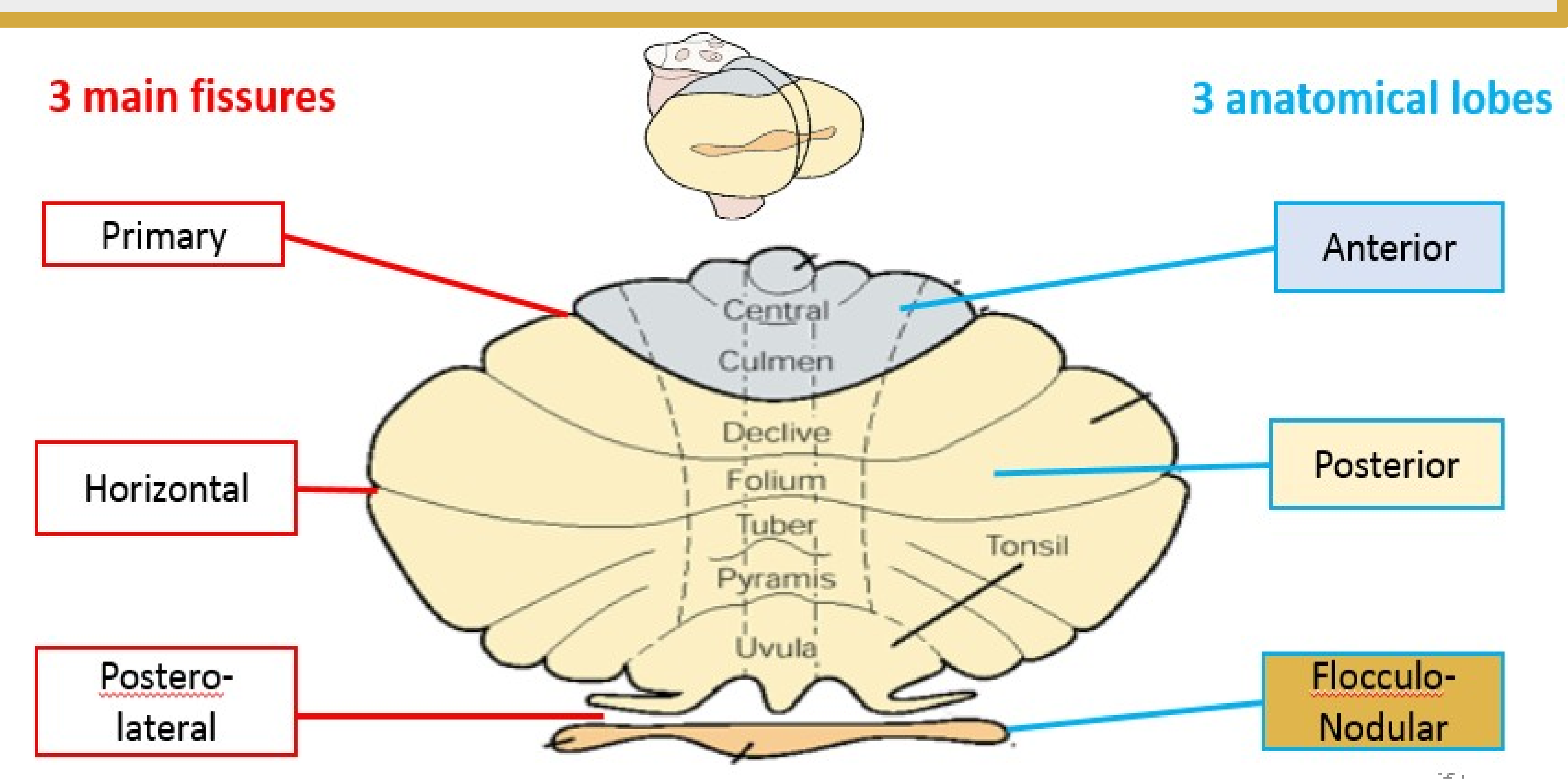


l fissure.





Lobes of the Cerebellum



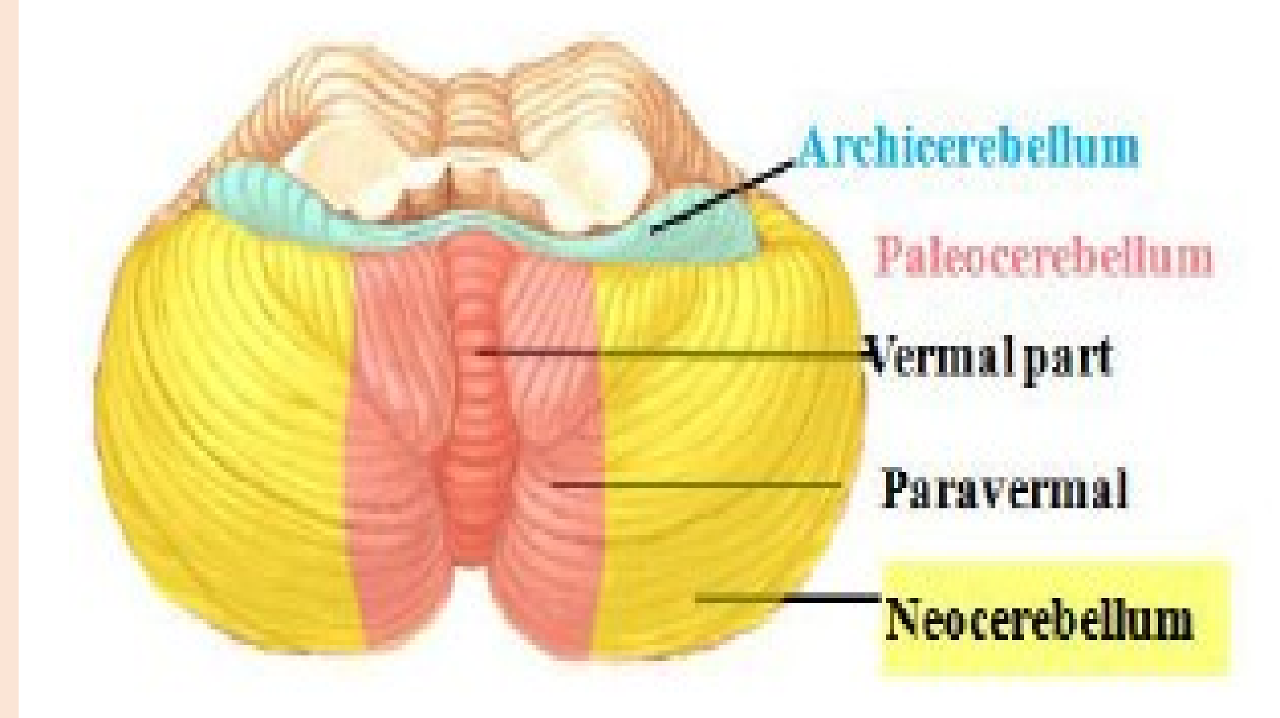
Lobes of the Cerebellum

Functionally the cerebellum is divided into 3 lobes:

1.Archicerebellum:

- **Its connections are vestibular.**
- **It is concerned with equilibrium.**
- **It is formed of:**

2 Flocculi + Nodule (part of inf. Vermis)



Lobes of the Cerebellum

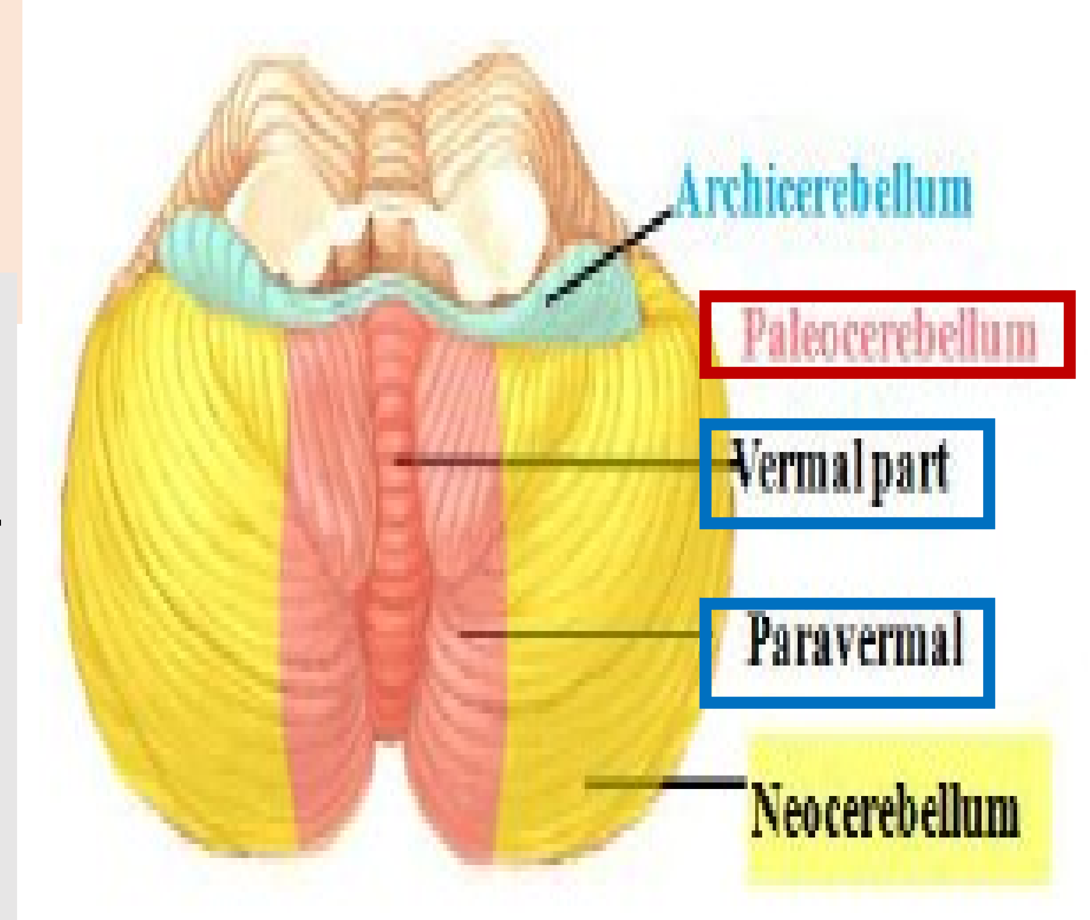
2.Paleocerebellum

- Its connections are spinal **(spinocerebellar)**
- It controls **muscle tone**, **posture** &

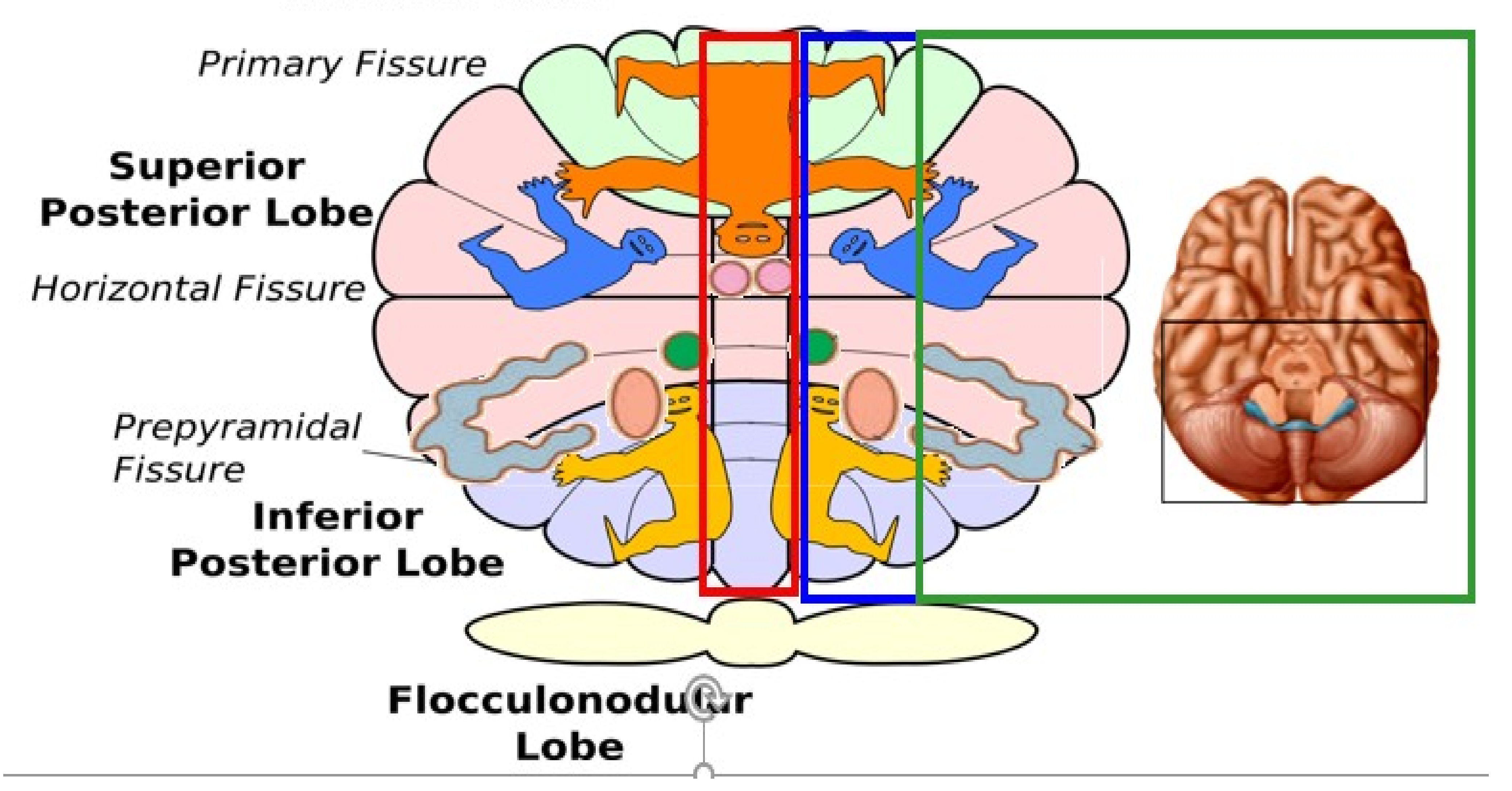
- It is formed of 3 parts:

a. **Vermal part:** includes the whole vermis. It has connections to the **trunk muscles of both sides** via the fastigial nucleus.

b. **2 paravermal parts** of the cerebellar hemispheres: are connected to the **distal limb muscles of the same side** via the globose and



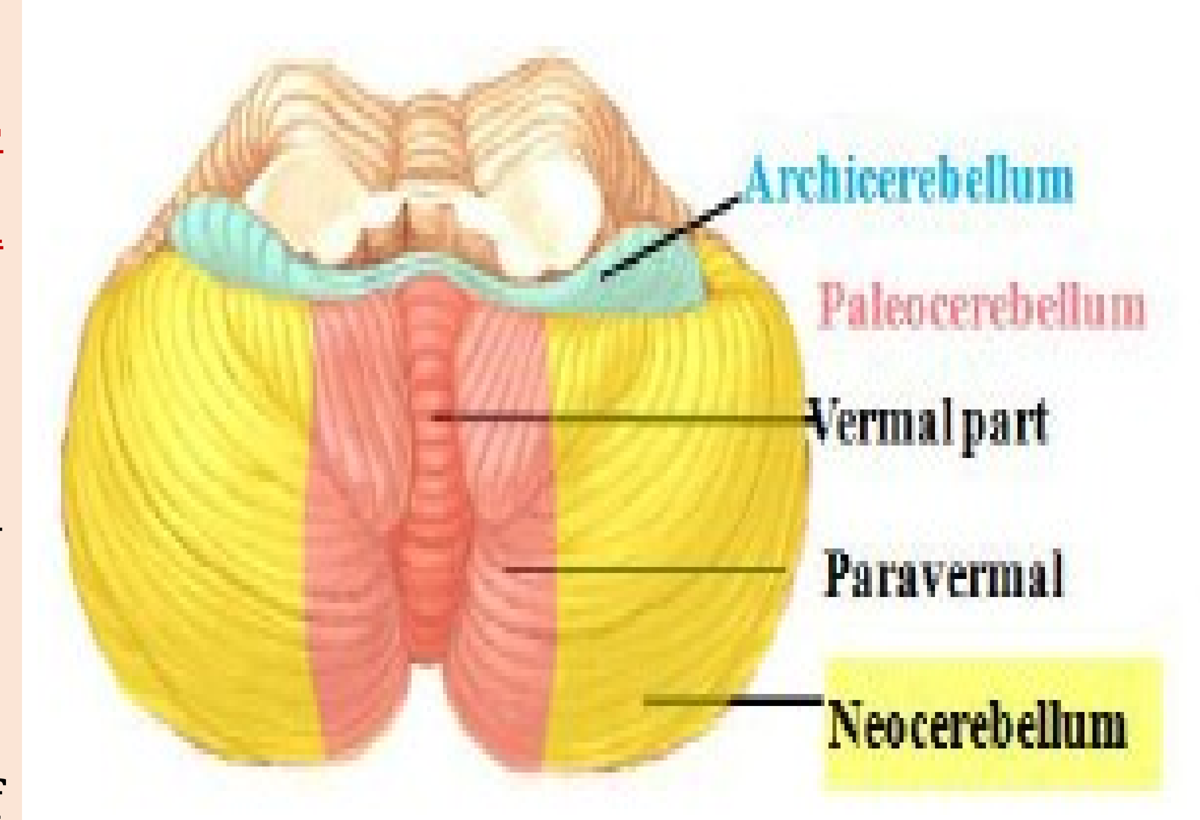
Functional Lobes of the Cerebellum



Lobes of the Cerebellum

3.Neocerebellum:

- Its connections are cortico-ponto-cerebellar & projects to the contralateral cerebral cortex via the dentate nucleus.
- It interacts with motor cortex in planning & programming movement.
- It is formed of the most lateral parts of cerebellar hemispheres.

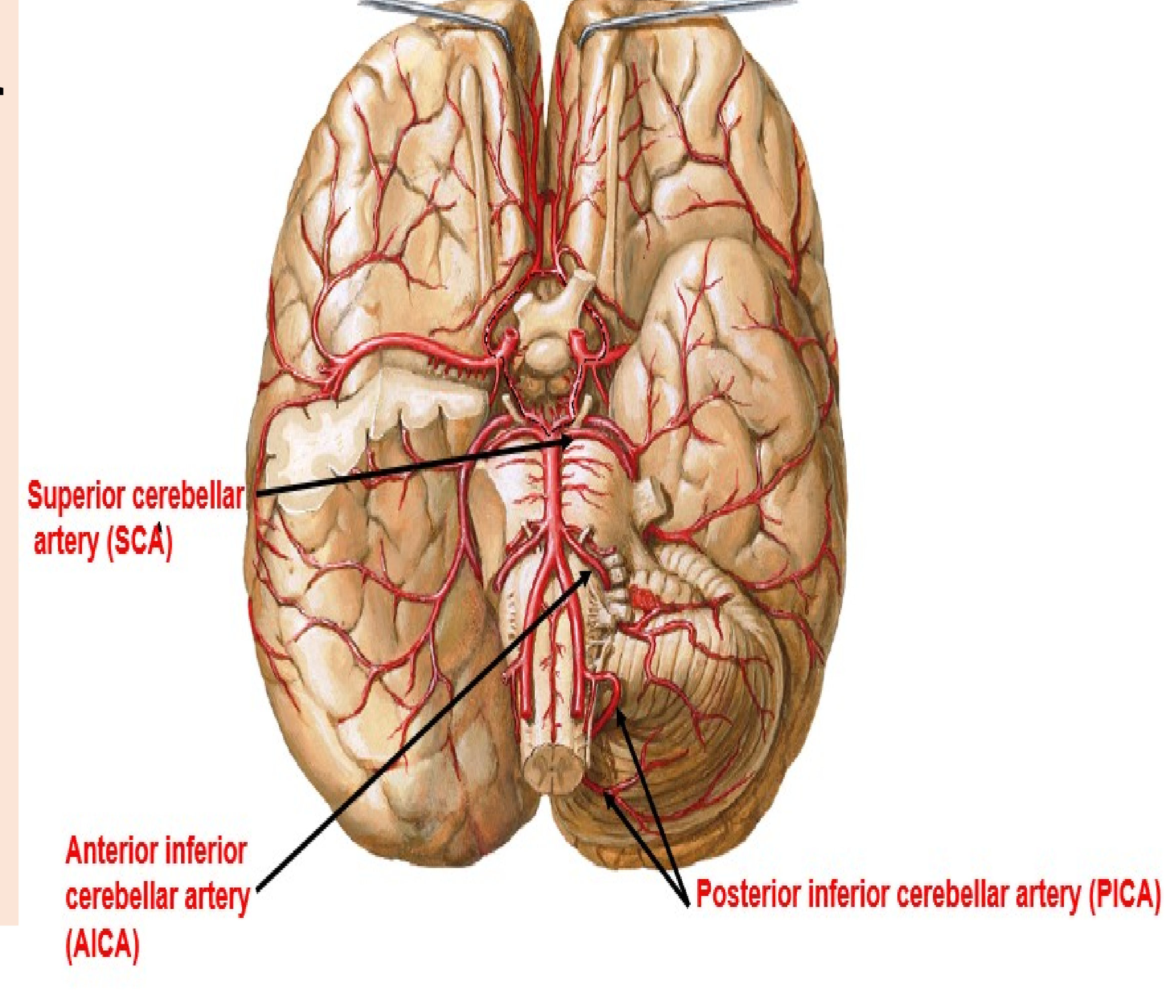


Arterial Blood Supply of the Cerebellum

One artery to the upper surface & 2 arteries to the lower surface:

1. **Superior cerebellar a. (br. of basilar)**
2. **Anterior-inferior cerebellar a. (br. of bas**
3. **Pos ellar a. (br. of ver**

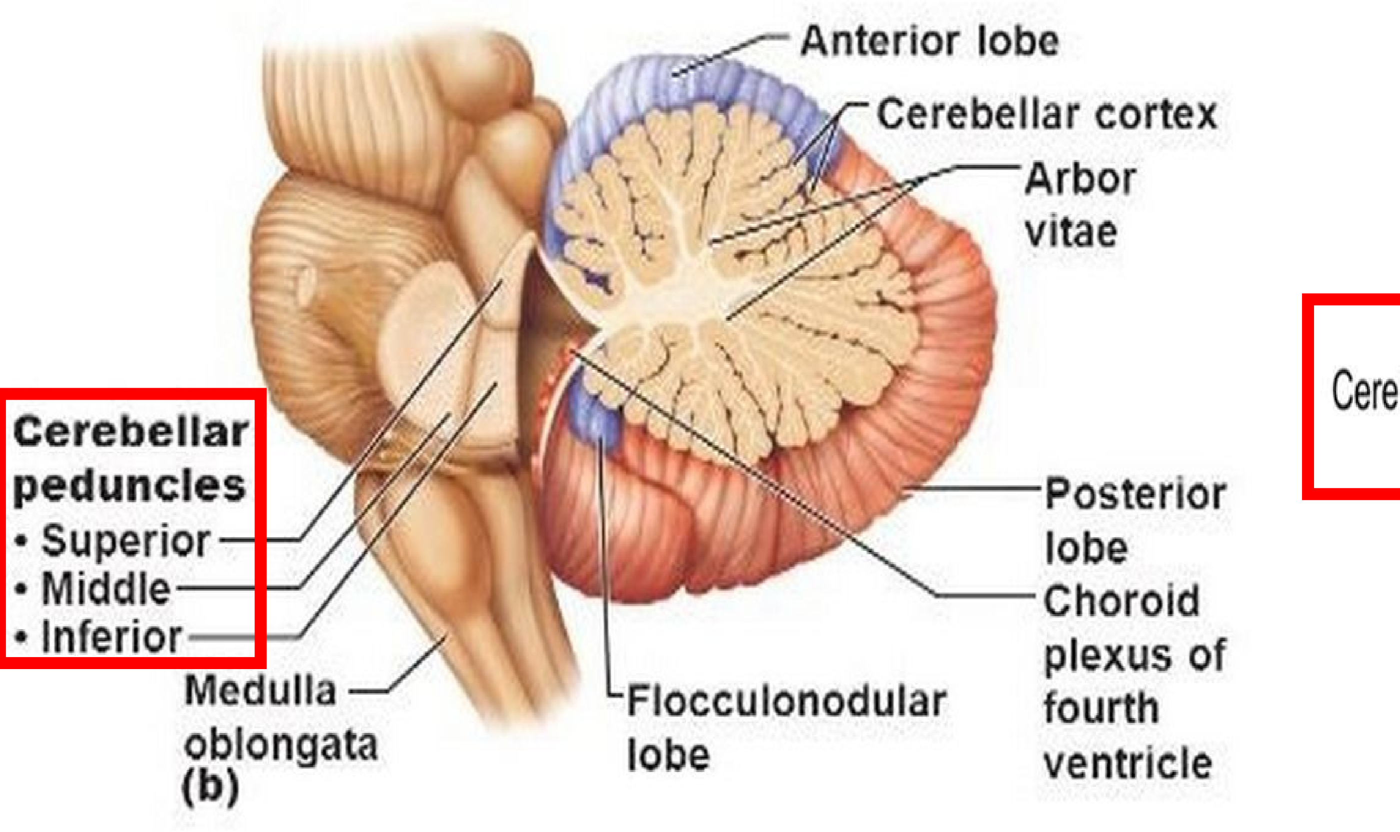
Superior
cerebellar artery
Anterior inferior
cerebellar artery
Posterior inferior
cerebellar artery

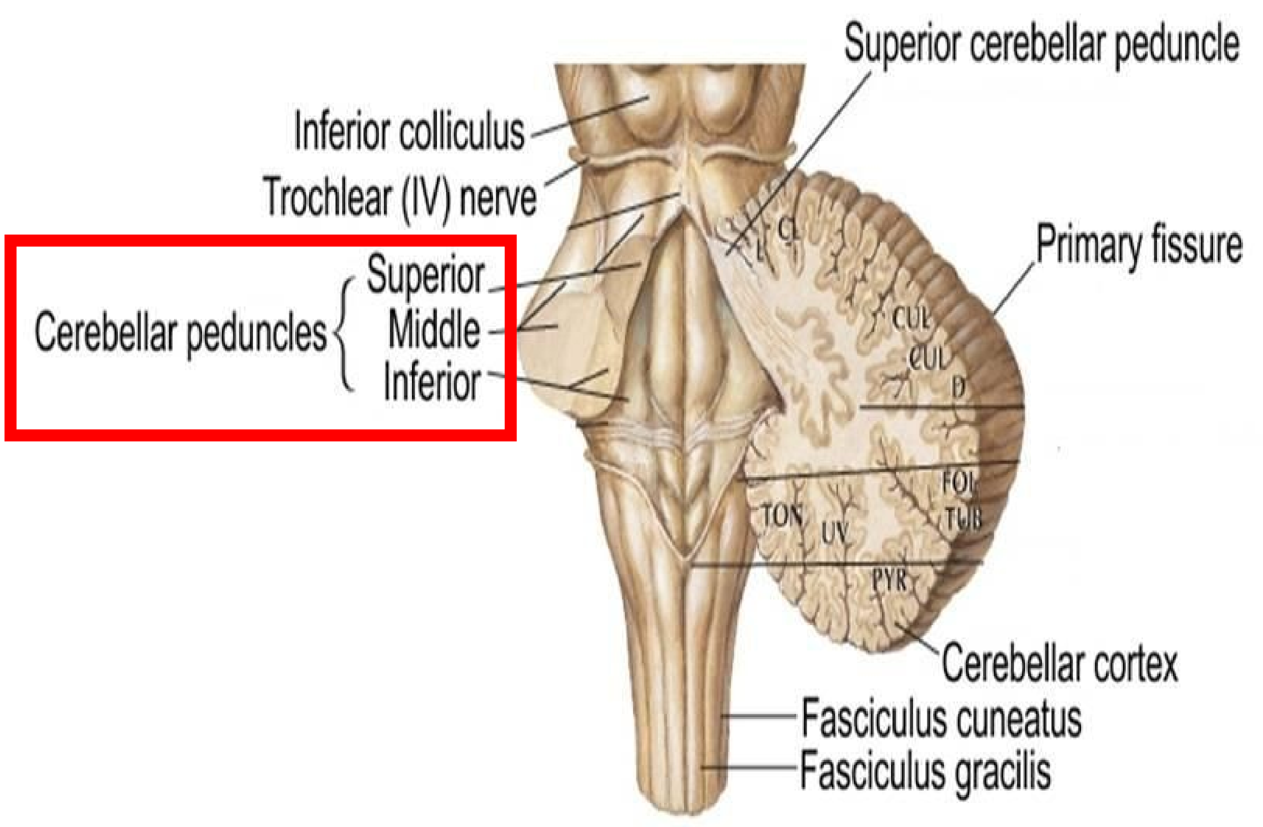


The Cerebellar Peduncles

Three pairs of peduncles attach cerebellum to the brain

Superior - Middle - Inferior







Histology

Prof. Dr. Walaa Baher

Ass. Professor of Histology

Internal Structure

Histological structure of the cerebellum



Gray matter

a) The outer cortex.
b) Four pairs of intrinsic cerebellar nuclei.

White matter

a) Afferent connections.
b) Efferent connections.

The cerebellar cortex



Composed of transverse folia.

Each folium contains a core of white matter covered by a gray matter.

Molecular layer

- Stellate cells
- Basket cells

Purkinje cell layer

- Purkinje cells

Granular layer

- Granule cells.
- Golgi type II cells.
- Cerebellar islands (Glomeruli)

The Molecular layer



Outer most layer.
Formed of two types of cells:

Basket cells	Stellate cells	
Deep part of the molecular layer	Superficial part of the molecular layer	**Site**
Found in the same layer		**Dendrites**
Form basket-like terminal arborizations around purkinje cell bodies. (a single cell makes synapse with many Purkinje cells up to 10 cells)	Pass parallel to the surface of the cerebellum, to synapse with the dendrites of purkinje cells	**Axons**

The molecular layer



Outer stellate cell

Molecular layer

Purkinje cell layer

Purkinje cell

P

P

P

Golgi cell

Basket cell

Granule cell

Glomerulus

Recurrent collateral

Granular layer

White matter

Climbing fibre

Mossy fibre

Afferents

Axons of Purkinje cells

Efferents

https://www.google.com/url?sa=i&source=images&cd=&ved=2ahUKEwi2xObPj4HlAhUx8AKHbBbCUUQjRx6BAgBEAQ&url=https%3A%2F%2Fwww.brainkart.com%2Farticle%2FBasic-Structure-of-the-Cerebellar-Cortex_18978%2F&psig=AOvVaw1Mbl54eke_AKdAWEANEjYO&ust=1570227434616301

The Molecular layer



Fibers of the molecular layer:

a) Dendritic arborizations and axons of its own cells.

b) The dendrites of cells in the deeper layers (purkinje cells and golgi type II cells).

c) Climbing fibers, the afferent fibers to the cerebellum.

d) Axons of granule cells which are oriented transversely and parallel to the long axis of folia.

The molecular layer



Outer stellate cell
Molecular layer
Purkinje cell layer
Granular layer
White matter
Purkinje cell
P
Golgi cell
Granule cell
Glomerulus
Basket cell
Recurrent collateral
Climbing fibre
Mossy fibre
Afferents
Axons of Purkinje cells
Efferents

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Purkinje Cell layer



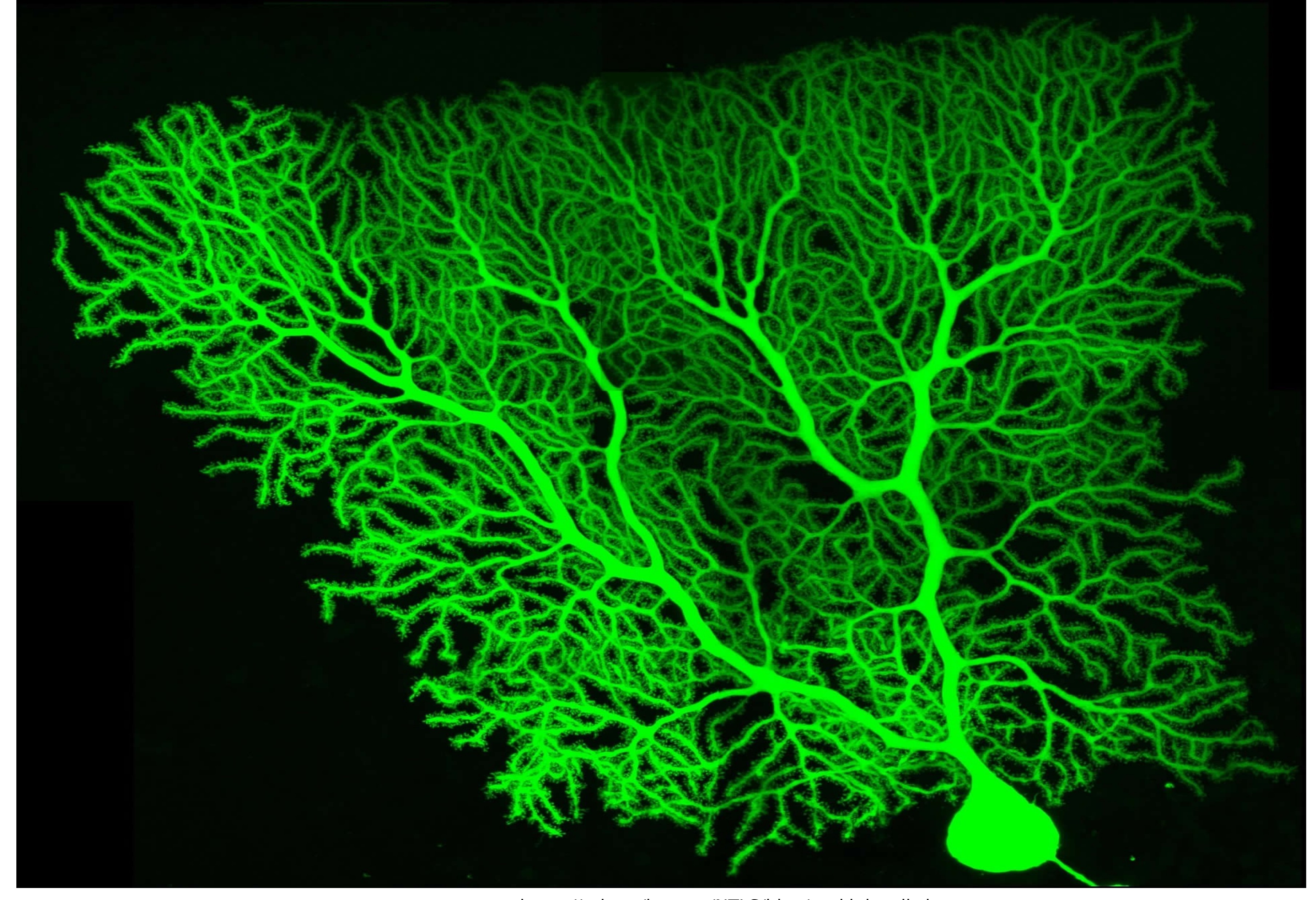
- The middle layer of the cerebellar cortex. formed of one type of cells (Purkinje cell)
- **Site:** These are large cells, arranged uniformly in a single plane along the upper margin of granular layer.
- **Cell body:** Each cell has a large flask-shaped cell body. It has a vesicular central nucleus and coarse cytoplasmic Nissl's granules.

Purkinje Cell layer



Dendrites:

- Form an elaborate fan-like dendritic tree, at right angles to the long axis of the surface.
- These dendrites branch to give rise to primary, secondary and tertiary branches.
- Primary and secondary branches are smooth, while the tertiary branches show spines.



https://ntls.co/images/NTLS/blog/purkinjecells.jpg

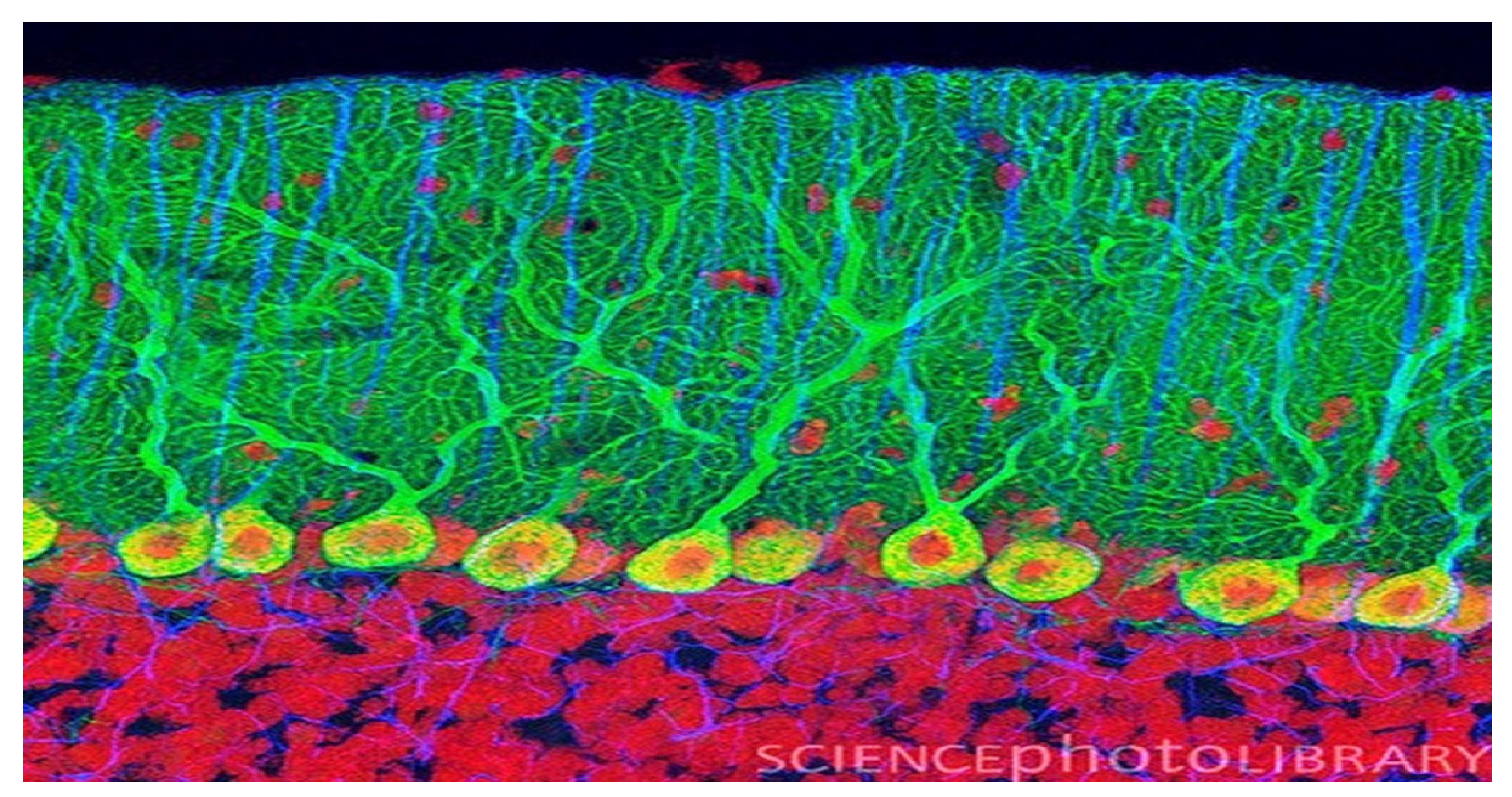
Purkinje Cell layer



- **Axons:**

- They represent the efferent pathway from the cortex.

- Myelinated passing through the granular layer and white matter to synapse with deep cerebellar nuclei. (Some axons bypass the deep cerebellar nuclei and leave the cerebellum to reach the vestibular nuclei).
- They give collaterals that synapse with Golgi type II and basket cells.



https://cdn.psychologytoday.com/sites/default/files/styles/image-article_inline_full/public/blogs/75174/2014/11/165396-169987.jpg?itok=7b6l-LqS

Granular layer



- Formed of closely packed cells separated by non cellular spaces called **cerebellar islands (Glomerulus).**
- There are two types of cells:

Granular layer



Golgi type II Cells	Granule Cells	
Found in the upper parts of the granular layer	Small cells having large rounded nuclei and thin rim of cytoplasm with few Nissl’s bodies	**Cell body**
Extend in all layers of the cortex	Show claw like endings that terminate in the glomerulus	**Dendrites**
End within the cerebellar glomeruli	Their axons ascend to the molecular layer, where they bifurcate to give rise to parallel fibers that synapse with dendrites of Purkinje	**Axons**

Granular layer



Cerebellar islands (Glomeruli):

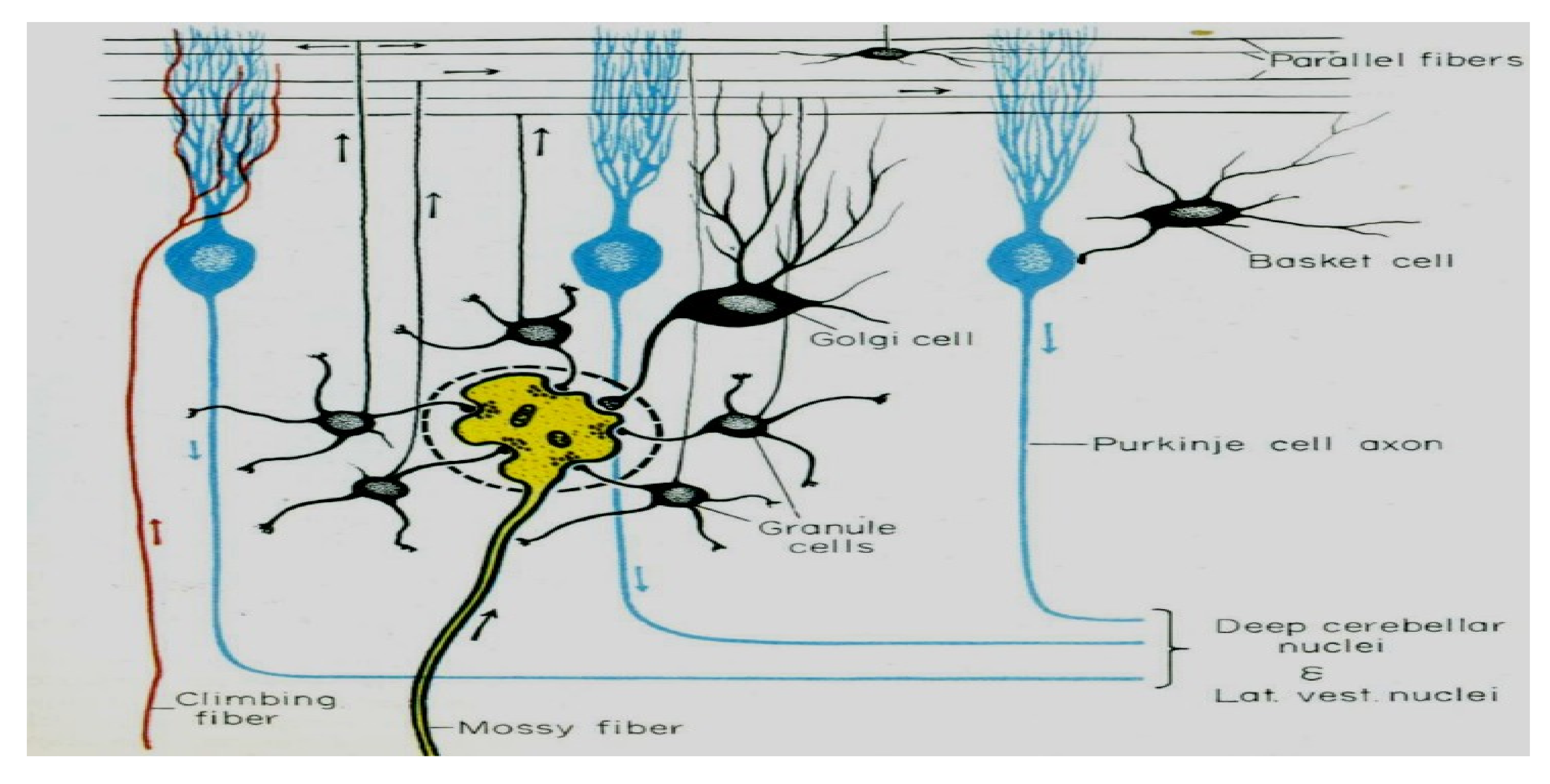
These are irregularly dispersed pale non cellular areas, composed of a complex synaptic structure formed of:

1) Mossy fiber terminal .
2) Dendrites of numerous granule cells.
3) Axons of Golgi type II ce

Function:

This structure excites granular cells which in turn excite purkinje cells. Axons of granule cells (unmyelinated fibers), ascend vertically to the molecular layer and synapses with Purkinje cell dendrites.

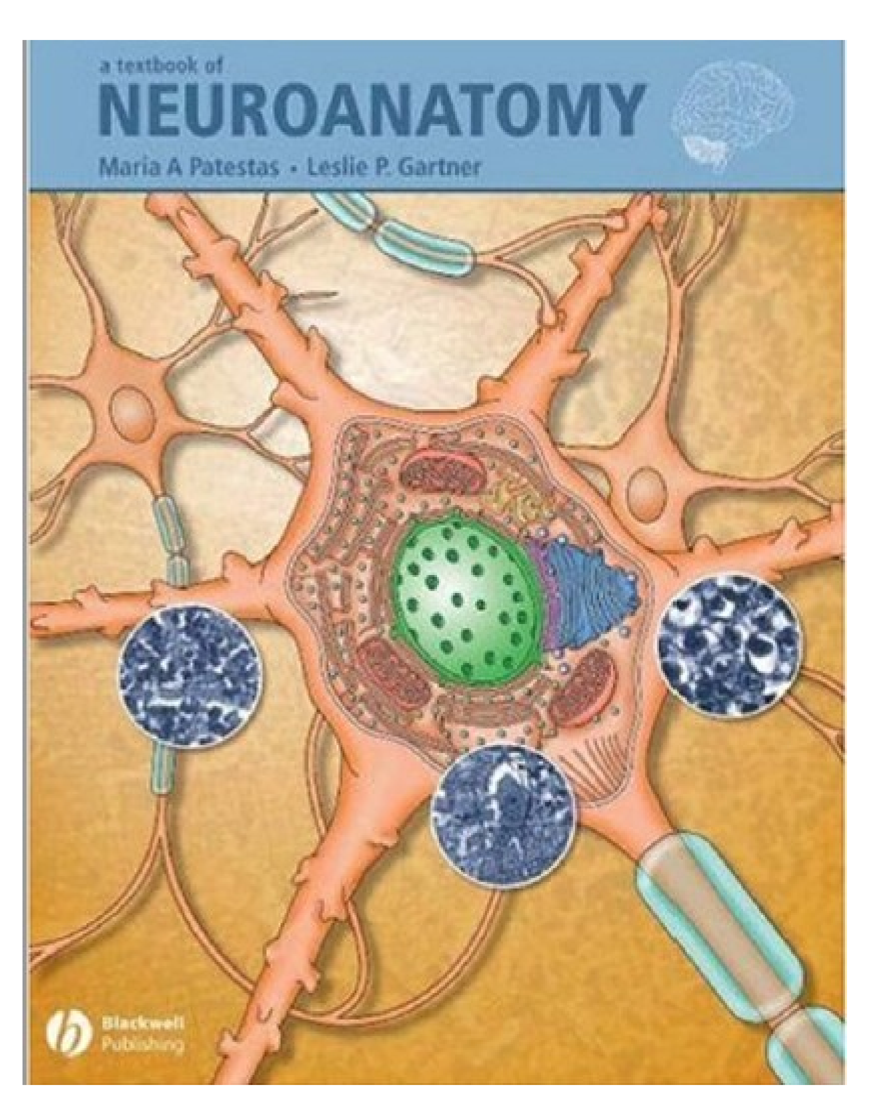
Granule cells are the only excitatory neurons in the cerebellar cortex.



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Suggested Textbooks






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THANK YOU